**(12.3)**

>> A= [10 2 -1; -3 -6 2; 1 1 5]

A =

10 2 -1

-3 -6 2

1 1 5

>> b=[27; -61.5; -21.5]

b =

27.0000

-61.5000

-21.5000

First, solve each of the equations for its unknown on the diagonal. Assume that x2 and x3 are 0, gives the following equation for x1:

>> x1 = (b(1,:)+ -A(1,2)\*0 - A(1,3)\*0)/A(1,1)

x1 =

2.7000

Then use this value, along with the assumed value of x3=0, and substitute these into the equation below:

>> x2 = (b(2,:)+ -A(2,1)\*x1 - A(2,3)\*0)/A(2,2)

x2 =

8.9000

Then substitute x1 and x2 into the equation below:

>> x3 = (b(3,:)+ -A(3,1)\*x1 - A(3,2)\*x2)/A(3,3)

x3 =

-6.6200

For the 2nd iteration, repeat the process above

To get the new value for x1, substitute x2 and x3 from above into the equation below:

>> x1 = (b(1,:)+ -A(1,2)\*x2 - A(1,3)\*x3)/A(1,1)

x1 =

0.2580

>> x2 = (b(2,:)+ -A(2,1)\*x1 - A(2,3)\*x3)/A(2,2)

x2 =

7.9143

>> x3 = (b(3,:)+ -A(3,1)\*x1 - A(3,2)\*x2)/A(3,3)

x3 =

-5.9345

The error for x1 is (2.7 is value for x1 from the 1st iteration):

>> eps\_x1 = abs((x1-2.7)/x1)\*100

eps\_x1 =

946.5116

This is much greater than eps\_s =5%, so must get new iterations

**For 3rd iteration**, I get the following values:

>> x1 = (b(1,:)+ -A(1,2)\*x2 - A(1,3)\*x3)/A(1,1)

x1 =

0.5237

>> x2 = (b(2,:)+ -A(2,1)\*x1 - A(2,3)\*x3)/A(2,2)

x2 =

8.0100

>> x3 = (b(3,:)+ -A(3,1)\*x1 - A(3,2)\*x2)/A(3,3)

x3 =

-6.0067

The %error for x1 is now (.258 is the value for x1 from the 2nd iteration):

>> eps\_x1 = abs((x1-.258)/x1)\*100

eps\_x1 =

50.7339

Since this %error is much greater than 5%, much repeat the iteration

**4th iteration**:

>> x1 = (b(1,:)+ -A(1,2)\*x2 - A(1,3)\*x3)/A(1,1)

x1 =

0.4973

>> x2 = (b(2,:)+ -A(2,1)\*x1 - A(2,3)\*x3)/A(2,2)

x2 =

7.9991

>> x3 = (b(3,:)+ -A(3,1)\*x1 - A(3,2)\*x2)/A(3,3)

x3 =

-5.9993

The %error for x1 is now (where .5237 is x1 from 3rd iteration):

>> eps\_x1 = abs((x1-.5237)/x1)\*100

eps\_x1 =

5.3032

This is still larger than 5%, so must get new iteration

**5th iteration:**

>> x1 = (b(1,:)+ -A(1,2)\*x2 - A(1,3)\*x3)/A(1,1)

x1 =

0.5003

>> x2 = (b(2,:)+ -A(2,1)\*x1 - A(2,3)\*x3)/A(2,2)

x2 =

8.0001

>> x3 = (b(3,:)+ -A(3,1)\*x1 - A(3,2)\*x2)/A(3,3)

x3 =

-6.0001

%error for x1 is now (.4973 is x1 from 4th iteration):

>> eps\_x1 = abs((x1-.4973)/x1)\*100

eps\_x1 =

0.5904

This is less than 5%. Now must check %errors for x2 and x3 (.79991 is x2 from 4th iteration, -5.9993 is x3 from 4th iteration):

>> eps\_x2 = abs((x2-7.9991)/x2)\*100

eps\_x2 =

0.0127

>> eps\_x3 = abs((x3+5.9993)/x3)\*100

eps\_x3 =

0.0129

**The solution is x1= .5003, x2=8.0001, x3=-6.0001**

**With %relative errors of: .5904% for x1, .0127% for x2, and .0129% for x3**

**(12.4)**

First, start with the same systems of equations as in prob 12.3

>> A= [10 2 -1; -3 -6 2; 1 1 5]

A =

10 2 -1

-3 -6 2

1 1 5

>> b=[27; -61.5; -21.5]

b =

27.0000

-61.5000

-21.5000

Then, use equations 12.1a, 12.1b, 12.1c from the book. For 12.1a, use initial guess of 0 for x2 and x3, so substitute 0 for x2 and x3

>> x1 = (b(1,:)+ -A(1,2)\*0 - A(1,3)\*0)/A(1,1)

x1 =

2.7000

For 12.1b, use initial guess of 0 for x1 and x3, so substitute 0 for x1 and x3

>> x2 = (b(2,:)+ -A(2,1)\*0 - A(2,3)\*0)/A(2,2)

x2 =

10.2500

For 12.1c, use initial guess of 0 for x1 and x2, so substitute 0 for x1 and x2

>> x3 = (b(3,:)+ -A(3,1)\*0 - A(3,2)\*0)/A(3,3)

x3 =

-4.3000

2nd iteration:

Now, use x2 and x3 from 1st iteration and substitute into equation 12.1a

>> x1\_2 = (b(1,:)+ -A(1,2)\*x2 - A(1,3)\*x3)/A(1,1)

x1\_2 =

0.2200

use x1 and x3 from 1st iteration and substitute into equation 12.1b

>> x2\_2 = (b(2,:)+ -A(2,1)\*x1 - A(2,3)\*x3)/A(2,2)

x2\_2 =

7.4667

use x1 and x2 from 1st iteration and substitute into equation 12.1c

>> x3\_2 = (b(3,:)+ -A(3,1)\*x1 - A(3,2)\*x2)/A(3,3)

x3\_2 =

-6.8900

The difference between x1 (From 1st iteration) and x1\_2 (x1 from 2nd iteration) is between 2.7 and .22, which is clearly larger than a 5% difference, so need 3rd iteration

3rd iteration:

Now, use x2\_2 and x3\_2 from 2nd iteration and substitute into equation 12.1a

>> x1\_3 = (b(1,:)+ -A(1,2)\*x2\_2 - A(1,3)\*x3\_2)/A(1,1)

x1\_3 =

0.5177

Now, use x1\_2 and x3\_2 from 2nd iteration and substitute into equation 12.1b

>> x2\_3 = (b(2,:)+ -A(2,1)\*x1\_2 - A(2,3)\*x3\_2)/A(2,2)

x2\_3 =

7.8433

Now, use x1\_2 and x2\_2 from 2nd iteration and substitute into equation 12.1c

>> x3\_3 = (b(3,:)+ -A(3,1)\*x1\_2 - A(3,2)\*x2\_2)/A(3,3)

x3\_3 =

-5.8373

Since x1 from 2nd iteration is x1\_2=.22 and x1 from 3rd iteration is x1\_3= 0.5177 and their %difference is clearly greater than 5%, need a 4th iteration

**4th iteration:**

Now, use x2\_3 and x3\_3 from 3rd iteration and substitute into equation 12.1a

>> x1\_4 = (b(1,:)+ -A(1,2)\*x2\_3 - A(1,3)\*x3\_3)/A(1,1)

x1\_4 =

0.5476

Now, use x1\_3 and x3\_3 from 3rd iteration and substitute into equation 12.1b

>> x2\_4 = (b(2,:)+ -A(2,1)\*x1\_3 - A(2,3)\*x3\_3)/A(2,2)

x2\_4 =

8.0454

Now, use x1\_3 and x2\_3 from 3rd iteration and substitute into equation 12.1c

>> x3\_4 = (b(3,:)+ -A(3,1)\*x1\_3 - A(3,2)\*x2\_3)/A(3,3)

x3\_4 =

-5.9722

Now, calculation for %relative error for x1 from iterations 4 and 3 is (x1\_4 is x1 from 4th iteration, x1\_3 is x1 from 3rd iteration):

>> eps\_x1 = abs((x1\_4-x1\_3)/x1\_4)\*100

eps\_x1 =

5.4663

This is greater than 5%, so need 5th iteration

5th iteration:

Now, use x2\_4 and x3\_4 from 4th iteration and substitute into equation 12.1a

>> x1\_5 = (b(1,:)+ -A(1,2)\*x2\_4 - A(1,3)\*x3\_4)/A(1,1)

x1\_5 =

0.4937

Now, use x1\_4 and x3\_4 from 4th iteration and substitute into equation 12.1b

>> x2\_5 = (b(2,:)+ -A(2,1)\*x1\_4 - A(2,3)\*x3\_4)/A(2,2)

x2\_5 =

7.9855

Now, use x1\_4 and x2\_4 from 4th iteration and substitute into equation 12.1c

>> x3\_5 = (b(3,:)+ -A(3,1)\*x1\_4 - A(3,2)\*x2\_4)/A(3,3)

x3\_5 =

-6.0186

Now, calculation for %relative error for x1 from iterations 4 and 5 is (x1\_4 is x1 from 4th iteration, x1\_5 is x1 from 5th iteration):

>> eps\_x1 = abs((x1\_5-x1\_4)/x1\_5)\*100

eps\_x1 =

10.9171

This is larger than 5%, so need 6th iteration

Now, use x2\_5 and x3\_5 from 5th iteration and substitute into equation 12.1a

>> x1\_6 = (b(1,:)+ -A(1,2)\*x2\_5 - A(1,3)\*x3\_5)/A(1,1)

x1\_6 =

0.5010

Now, use x1\_5 and x3\_5 from 5th iteration and substitute into equation 12.1b

>> x2\_6 = (b(2,:)+ -A(2,1)\*x1\_5 - A(2,3)\*x3\_5)/A(2,2)

x2\_6 =

7.9969

Now, use x1\_5 and x2\_5 from 5th iteration and substitute into equation 12.1c

>> x3\_6 = (b(3,:)+ -A(3,1)\*x1\_5 - A(3,2)\*x2\_5)/A(3,3)

x3\_6 =

-5.9958

Now, calculation for %relative error for x1 from iterations 6 and 5 is (x1\_6 is x1 from 6th iteration, x1\_5 is x1 from 5th iteration):

>> eps\_x1 = abs((x1\_6-x1\_5)/x1\_6)\*100

eps\_x1 =

1.4659

This is less than 5%. Now must check %errors for x2 and x3 (x2\_6 is x2 from 6th iteration, x2\_5 is x2 from 5th iteration, x3\_6 is x3 from 6th iteration, x3\_5 is x3 from 5th iteration)

>> eps\_x2 = abs((x2\_6-x2\_5)/x2\_6)\*100

eps\_x2 =

0.1436

>> eps\_x3 = abs((x3\_6-x3\_5)/x3\_6)\*100

eps\_x3 =

0.3797

These are both less than 5% each, so the iteration is complete

**The solution is x1= .501, x2=7.9969, x3=-5.9958**

**With %relative errors of: 1.4659% for x1, .1436% for x2, and .3797% for x3**

**(13.4)**

From fig P13.4

**(13.5)**

>> m1=1, m2=1, m3=1, k=2

m1 =

1

m2 =

1

m3 =

1

k =

2

>> A=[2\*k -k -k; -k 2\*k -k; -k -k 2\*k]

A =

4 -2 -2

-2 4 -2

-2 -2 4

>> e=eig(A)

e =

-0.0000

6.0000

6.0000

**The eigenvalues are 0, 6 ,6**

Since -(-(w^2))\*M\*X’’ = w^2\*M\*X = K\*X, where M is the matrix with masses as diagonal entries, K is the matrix with k’s as entries

Therefore , the eigenvalues for the K matrix are 0, 6 and 6

Then, set m1\*w1^2 = 0 => w1=0

M1\*w2^2=6 => w2=sqrt(6) = 2.45

M1\*w3^2 = 6 => w3= 2.45

**The frequencies w are w1=0, w2=2.45, w3= 2.45**